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"Breed, Weed, Feed--Then Gain Speed"

WATCH YOUR STEP

By DR. N. W. SANBORN, Associate Editor.

PART XIV

APRIL is a month of promise. The early chickens are beyond the danger age, the bulk of the season's crop of chicks come out of the eggs this month. The incubators are full, the brooders well occupied, the laying stock busy on the nests, and the shipping of hatching eggs at its height. In the barn the cows are sniffing at the breezes that tell of grass that will soon be green; the horses are getting full grain rations that they may be ready for the spring drive of ploughing; out in the orchards the bark is getting fresh in color and the buds are swelling. The maple sap has been boiled down, made into splendid syrup, and will help out on the sweet shortage of the year.

Eggs held up well in price through March, not dropping much below half a dollar a dozen, and will not touch prices of previous seasons. Even at present egg prices there is little profit when you count in the high cost of feeding through the dark, long, hard, winter of 1917-18. There was a decided shortage in eggs through the winter, the lowest yield that we ever had. The yearling hens, and pullets, are all at work, seeming to be trying to make up for the small number of eggs in the last four months.

The poultry seems to be in splendid condition, fertility running good, and chicks coming out with every evidence of high vigor.

What Are Your Plans?

The man who does not plan this spring, who does not use forethought, will be sorry in the autumn. It is no time to the "taking things as they come." You must push, on the farm, and in the poultry work, as never before.

It will be long hours of work, short noonings, for most folks on the farm. It was hard to hire fair help last year, it will be sometime impossible to get any help this spring and summer. While we should hatch what chicks we think we ought, we must not have numbers that we cannot properly feed and care for. Good chickens, well grown, will be worth owning, but slow maturing, half fed, pullets will be money losers for us.

It should be smaller breeding pens, fewer poor stock in them, and eggs more carefully culled before setting. Second quality chicks, as they come from the machines or from under the hens, ought to be put out of the way. Kill them and feed the grain they would otherwise eat to the choice ones you reserve. Cull all along the weeks up to the filling the pens with layers in the autumn.

Plan to know more of the laying condition of your stock. You cannot afford to keep, over night, a hen that will not pay her way through the summer months. You must have some plan, some system, of picking out these slacker hens. Turn them right into good meat.

It will take the most careful planning to properly feed our chicks and laying stock this year. We have to feed what we can find in our grain stores. Many of the common grains of the past are out of our reach. We are limited in wheat and rye, red dog and "arlington" are now going to make bread; it is a question as whether we shall be able to buy bran and middlings when we need them. It is not a question of putting together a perfectly balanced ration, but whether we can get one that will answer for fair results. There has not been two months this past year when my mash and scratch feed have been equal to my standard ration of a year ago this spring. I have had to feed as best I could.

Through March my dry mash was by measure; one of hominy, one of cornmeal, one bran, one brown middlings, one cut alfalfa, one beef scrap. My scratch feed was also by measure: one of wheat, three of big oats, six of cracked corn. Mangels were fed at noon, oyster shells given. Snow used in the early days of the month, and water later, as the weather was less severe. The egg yield increased under this feed, but it would have done that under any sort of feed in the month of March. Until the females got well into laying they were slightly fatter than I like, but a few weeks' laying took off the surplus fat, putting it into the yolks of the eggs, and they got down to good working shape.

Out On the Farm.

Of all years this is the one to do our best with the soil of our farms. Foods are scarce, high, many out of the market, and we must raise more food on the farm or go without. Not only must the poultry be fed, the cows and horses be provisioned, but the family needs more garden foods than ever before. We cannot run out to the grocery and buy—as in past years. The grocery stock is low, prices running up, and we must feed ourselves from our own land as never before.

Fresh Soil for Young Chicks.

By W. W. Kazmeier, Poultry Husbandman, Extension Service A. and M. College of Texas.

Since the time is approaching when brooder chicks will arrive in large numbers it is well to bear in mind the importance of providing a place where the small chicks may scratch in well pulverized soil. There is a mineral substance contained in freshly turned earth that is not to be found in any grain or green food and has been found to be a splendid supplement to grain and meal feeds. Leg weakness is often caused by deprivation of scratching in freshly pulverized earth, and besides this, exercise is essential to the all-around expansion of their external and internal organs which is necessary in the proper development of the young chicks.

Remember that fresh air, fresh water, freshly pulverized soil, fresh green feed, sanitary conditions and plenty of exercise are essentials which must be provided for the successful care of young chicks, whether in the back lot or country and too much emphasis can not be placed upon their necessity. The provision of a small piece of freshly turned earth guarantees the exercise and fresh air necessary to appetite and appetite is the one master which drives the brute and fowl creation to work, searching for food essential to proper development.

Note the preference of chicks for flower beds, etc., in the spring and you will realize the importance of providing such a place for them to scratch.

Poultry Manure Should Be Saved for Fertilizer.

It May Be Used Alone for Nitrogen Content or Reinforced With Acid Phosphate.

Poultry manure is quoted in some trucking sections at $12 to $15 a ton, and if well cared for it will have a plant food content which makes this a fair price as compared with the cost of commercial fertilizers. Figures show that from 100 hens about two tons of dry droppings should be collectable under the roosts each year, or forty pounds per bird. Probably nearly as much will be in the scratch litter where the chicks are confined all or most of the time. This is a by-product of the industry worth considering.

The plant food in the droppings is readily soluble and quick acting, but, like nitrate of soda, it is not a complete fertilizer; this percentage of phosphoric acid and potash is low. The manure alone will stimulate a rank growth of leaf and vine, but to produce fruit or grain it should be reinforced with phosphoric acid.

According to the specialist in soil fertility of the New Jersey State Agricultural College, the best reinforcing material is acid phosphate, which can be bought for $25 or less per ton. To make a fertilizer coresponding to a 3—8—1, which would be suitable for most crops, acid phosphate should be mixed with the clear, dry droppings at the rate of one pound of phosphate to four or five of manure, or 500 pounds to the ton. Such a mixture has just about half the strength of the commercial 3—8—1 and should therefore be used in about double the amount per acre.

The phosphate also helps prevent fermentation and the loss of ammonia from the manure. Land plaster, or gypsum, is sometimes used for this purpose, but the phosphate is nearly two-thirds gypsum and the gypsum contains no plant food. If one pound of phosphate is scattered under the roosts weekly for every five birds it will give about the right proportion and its full efficiency as a preservative will be secured.

Whether the poultry manure will retain its full fertilizing value or not depends on how it is held after collecting and before the time comes for its use in the garden and field. The manure must be held under cover to prevent its leaching and heating. When acid phosphate or other form of plant food material is not used with the droppings the manure should have dry earth, the siftings of coal ashes or some such absorbent mixed with it to take up the moisture and thereby prevent fermentation. In the same way the litter used on the poultry house floor should be saved under the protection of a shed to keep it dry. If it is exposed to the rains and snows, heating begins, and the soluble plant food passes into the air or leaches out. The manure from the poultry can be made the most valuable of that produced by farm animals, or it can be rendered very low in fertility, according to the manner in which it is cared for after it is taken from the poultry house. With plain food so scarce and expensive, use every care to conserve that produced by the poultry department.

and nitrophenide were about of equal value.

From the standpoints of mortality from caecal coccidiosis, average weight, and feed efficiency, the continuous treatment method gave better results than did intermittent treatment.

LITERATURE CITED

1. Allen, R. W., and Farr, M. M., Sulfaguanidine as a prophylactic during the period of acquirement of resistance by chickens to caecal coccidiosis. American Journal of Veterinary Research *4*, 50 (1943).
2. Delaplane, J. F., Batchelder, R. M., and T. C. Higgins, Sulfaquinoxaline in the prevention of Eimera tenella infections in chickens. The North American Veterinarian, *28*, 19-24 (1947).
3. Farr, M. M., and Allen, W., Sulfaguanidine feeding as a control measure for caecal coccidiosis in chickens. Journal American Veterinary Medical Association *100*, 47-51 (1942).
4. Grumbles, L. C., Delaplane, J. P., and Higgins, T. C., Sulfaquinoxaline in the control of Eimeria tenella and Eimeria necatrix in chickens on a commercial broiler farm. Science, 107, 196 (1948).
5. Grumbles, L. C., Delaplane, J. P., and Higgins, T. C., Immunity Studies on Eimeria tenella infection in chickens in relation to sulfaquinoxaline therapy. PoultryScience, 27, 169-171 (1948).
6. Grumbles, L. C., and Delaplane, J. P., Relative activity of sulfamethazine and sulfaquinoxaline against Eimeria tenella infection in young chickens. American Journal of Veterinary Research, *9*, 306-309 (1948).
7. Levine, P. P., The coccidiostatic effect of sulfaguanidine (sulfanilyl guanidine). Cornell Veterinarian *30*, 107-112 (1941).
8. Seeger, K. C., The response of induced and natural Eimeria tenella infections to sulfaguanidine. Proc. of the Forty-ninth Annual Meeting of the United States Livestock Sanitary Association 45-48 (1945).
9. Seeger, K. C. and Tomhave, A. E., Effect of sulfaguanidine on caecal coccidiosis. University of Delaware Bulletin *260*, 1-19 (1946).

Poultry Manure

As a Fertilizer for Vegetable Crops

by E. M. Rahn

Broadcasting Poultry Manure Over a Cover Crop During the Winter is Most Effective.

University of Delaware
Agricultural Experiment Station
Newark, Delaware

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Poultry Manure

As a Fertilizer for Vegetable Crops

by

E. M. Rahn

In poultry manure, vegetable growers of Delaware have a vast supply of fertilizing material at a low cost. Thousands of tons are at their disposal each year since the greatest broiler producing area of the world is centered in Delaware. Some growers think it has great crop-producing value, others do not for various reasons. Some claim that it results in the production of excess foliage at the expense of seeds and fruit, that it burns seedling plants, and that it creates a weed problem. Others claim that commercial fertilizers are cheaper and easier to apply. In order to establish the value of poultry manure and the most efficient methods for its application, certain experiments were conducted for four years at the Delaware Agricultural Experiment Station. The present report considers the time, rate, and method of poultry manure application as applied to the following crops: tomatoes, cantaloupes, watermelons, and lima beans.[1]

REVIEW OF PREVIOUS WORK

The crop-producing value of poultry manure has in the past been based more on farm experience than on experimental evidence. Experiment station workers, no doubt, have overlooked poultry manure because until recently it has been much less available than barnyard or stable manure. Only a few experimental results have been reported on its use. Greve (3) in Delaware found that poultry manure was unsatisfactory for strawberries when placed five inches deep in the row before planting. Rahn and Phillips (7) found poultry manure most effective for cantaloupes when sidedressed just before the time vines started to spread. A rate of 2½-tons per acre was used. Rahn (5, 6), working with cantaloupes, found: (a) that poultry manure when placed in the furrow at a 5-ton per acre rate was effective in years of good rainfall but harmful in dry years due in part to a reduction in stand; and (b) that, if poultry manure is placed in the furrow, it was more effective when placed there one month rather than one week or five months previous to seeding. Donaldson (2) in Massachusetts reported that for a number of vegetable crops twelve tons of poultry manure reinforced with 400 to 500 pounds of 0-20-20 fertilizer compared favorably with chemical fertilizers and horse manure in a 24-ton per acre application.

[1]The lima bean experiments were made possible through the cooperation of the Research Department of Libby, McNeill and Libby Company. Acknowledgements are due particularly to A. Lepore.

Several experiments on conservation of poultry manure have been reported notably in New Jersey (9) and Pennsylvania (8). Superphosphate was found to be particularly effective as a preservative of nitrogen in the manure. Land plaster (Gypsum) and borax were also fairly effective in this respect.

DESCRIPTION OF EXPERIMENTS

The tomato, cantaloupe, and watermelon experiments were located on the Substation farm near Georgetown on Norfolk loamy sand. The lima bean experiments were conducted near Houston on Sassafras loamy sand. Soils were of low to medium fertility with a pH of about 6.1. Treatments in all experiments except with lima beans were replicated five times using approximately 1/40-acre plots. The lima bean treatments were replicated three times using 1/20-acre plots. A randomized-block design was employed in all experiments. For all crops except lima beans, a two-year rotation was followed, rye or wheat, which was not fertilized, being the intervening crop. Plant spacings were as follows: tomatoes, 2½ by 5 feet; cantaloupes, 2 by 6 feet; watermelons, 8 by 8 feet, one plant per hill; and lima beans, rows 32 inches apart with a seeding rate of 50 pounds per acre. Tomato and lima bean plots contained four rows, while cantaloupe and watermelon only three. To eliminate possible border effects, records were not taken on the two outside rows, except on the watermelon plots. With this crop, records were taken on all three rows since it was assumed that there was little border effect with rows spaced eight feet apart.

The varieties grown were Rutgers tomato, Jumbo Hale's Best cantaloupe, Hawkesbury or Coker watermelon, and Henderson's Bush lima beans.

Poultry manure in most cases was taken directly from broiler houses where the litter was either wood shavings or peanut hulls. Superphosphate (20%) was added to all poultry manure, except that for lima bean plots and certain indicated treatments with the other crops. Weekly applications were made to the manure on the broiler house floor so that each ton of manure finally contained 100 pounds of superphosphate. Stable manure which was used in the cantaloupe and watermelon experiments was taken directly from horse stables. The average analyses of the manures are listed in Table 1. Cantaloupe and watermelon plots were plowed in March, tomato plots in April, and lima bean plots in May.

Table 1. Average Analyses of Manures (Fresh Weight Basis) in Per Cent.

Kind of Manure	Moisture	N	P_2O_5	K_2O
Poultry	28	1.5	1.0	0.9
Poultry, with superphosphate, 100 pounds per ton	33	1.8	1.3	1.0
Stable	64	0.4	0.3	0.3

Table 2. Rainfall During May, June, July, and August

Year	Rainfall, Inches				
	May	June	July	August	Total
1945	4.09	4.43	10.76	2.42	21.70
1946	5.22	3.39	7.21	5.93	21.75
1947	3.00	2.21	4.28	4.11	13.60
1948	11.02	7.29	8.04	8.40	34.75

Crops were grown and harvested as is normally done in this area. Yield records consisted of the following: tomatoes, weight of marketable fruits of U.S. grades No. 1 and No. 2; cantaloupes, number and weight of marketable fruit including number of jumbos (fruits five inches or more in diameter); watermelons, number and weight of marketable fruit; and lima beans, weight of shelled beans as shelled by a commercial viner.

Rainfall records for the months of May, June, July, and August for each of the four years are presented in Table 2. It can be seen that rainfall was fairly abundant each year except in 1947 when the four-month total for this period was 3.92 inches below the average 17.52 inches. Crops did not appear to suffer seriously from drought in this season, however.

Description of Application Methods Used

Methods of applying manure and fertilizer hereinafter referred to in the tables, figures, and text are described below:

1. *Broadcasting.* A uniform application of fertilizer or manure over the soil surface.

2. *Plowing down.* A uniform application of fertilizer or manure over the soil surface immediately before plowing. A grain drill was used to apply fertilizer to the tomato plots while fertilizer was spread by hand on the lima bean plots.

3. *Banding.* Application of fertilizer at seeding in narrow bands six inches to each side of row and three inches deep for cantaloupes; for watermelons broken bands, three feet long, were made eight inches to each side of row and three inches deep.

4. *Sidedressing.* Application of manure in bands a foot wide on each side of the plant row about a month after seeding or planting; or in the case of commercial fertilizer, narrow bands on each side of the plant row.

5. *In Furrow.* Placement and covering of manure in furrows eight inches deep about a month before seeding.

6. *Over Furrow.* Broadcasting manure with regular manure spreader, straddling the open furrow, followed by closing furrow immediately. Done about a month before seeding.

7. *In Hills.* Placement and covering of manure eight inches deep in hills eight feet apart for watermelons. Done about a month before seeding.

EXPERIMENTAL RESULTS

Tomatoes

Results of the tomato experiments are presented in Table 3. The four-

Table 3. Effectiveness of Poultry Manure and certain Commercial Fertilizers on the Marketable Yields of Tomatoes.

Treatment (Application per Acre)	Tons per Acre				
	1945	1946	1947	1948	Average
1. 4-8-12, 1200 lbs., plowed down	7.88	4.74	6.99	3.96	5.89
2. Poultry Manure, 5 tons, broadcast in December	8.21	6.58	10.46	5.96	7.80
3. Poultry Manure, 10 tons, broadcast in December	6.72	9.57	9.59	7.07	8.24
4. Poultry Manure, 5 tons, broadcast in December + Muriate of Potash (60%), 100 lbs., broadcast after plowing	8.08	7.27	8.46	6.43	7.56
5. Poultry Manure, 5 tons, broadcast in December + 4-8-12, 600 lbs., plowed down	7.49	7.11	8.82	5.47	7.22
6. Poultry Manure, 10 tons, broadcast in December + 4-8-12, 600 lbs., plowed down	5.11	10.96	8.95	6.67	7.92
7. Poultry Manure, 5 tons, plowed down + 4-8-12, 600 lbs., plowed down	8.86	6.80	9.81	4.97	7.61
8. Poultry Manure, not treated with superphosphate, 5 tons, plowed down + 4-8-12, 600 lbs., plowed down	8.15	7.42	11.26	4.66	7.87
9. Poultry Manure, 10 tons, plowed down + 4-8-12, 600 lbs., plowed down	7.89	10.94	8.97	5.23	8.26
10. Poultry Manure, 5 tons, broadcast after plowing + 4-8-12, 600 lbs., plowed down	9.32	6.88	9.47	5.33	7.75
11. Poultry Manure, 10 tons, broadcast after plowing + 4-8-12, 600 lbs., plowed down	9.03	11.67	10.10	5.67	9.12
12. Poultry Manure, 5 tons, sidedressed + 4-8-12, 600 lbs., plowed down	10.26	5.97	10.46	4.27	7.74
13. Poultry Manure, 10 tons, sidedressed + 4-8-12, 600 lbs., plowed down	10.07	9.78	9.65	5.21	8.68
14. Nothing	4.91	3.15	3.86	2.83	3.69
L.S.D. at 5% point	1.24	2.23	2.02	0.59	1.66

year-average yields show that poultry manure increased yields considerably above those obtained by the use of commercial fertilizer. This is illustrated graphically in Figure 1 where yield comparisons are made between

plots which received poultry manure alone, a combination of poultry manure and commercial fertilizer, and those which received commercial fertilizer alone. In this comparison, five tons of poultry manure alone (Treatment 2) increased tomato yields by 1.91 tons per acre over the plots which received 1200 pounds of a 4-8-12 fertilizer (Treatment 1). By increasing the poultry manure application from five to ten tons (Treatment 3), the yield was slightly increased by an additional 0.44 tons per acre. A comparison of poultry manure alone and a combination of poultry manure and commercial fertilizer reveals that the additional commercial fertilizer was of little value in these tests. The average yield from plots receiving five tons of manure (Treatment 2) was 7.80 tons. When 600 pounds of 4-8-12 fertilizer and five tons of manure were used (Treatment 5), the yield was 7.22 tons per acre. When the rate of manure application was ten tons, comparable yield figures from Treatments 3 and 6 were 8.24 and 7.92 tons, indicating no response from the use of 4-8-12 fertilizer.

Poultry manure was applied at four different times: In December broadcast on the rye or wheat cover crop (Treatments 5 and 6); in April broadcast before plowing (Treatments 7 and 9); in April after plowing the cover crop (Treatments 10 and 11); and in June as a sidedressing (Treatments 12 and 13). In addition to the poultry manure, 600 pounds of 4-8-12 per acre were plowed down. The average tomato

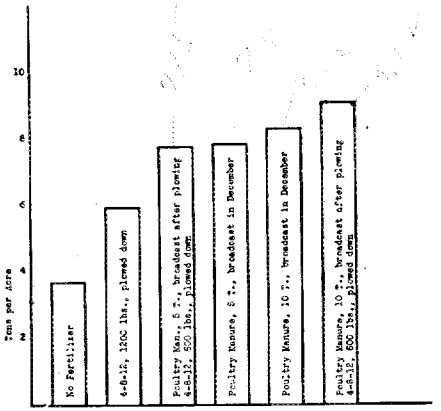

Figure 1. A comparison of average (4 years) tomato yields showing the superiority of poultry manure with or without commercial fertilizer over commercial fertilizer alone.

yields were not significantly affected either at the 5- or 10-ton per acre levels by time of application. However, in certain years, time of application had a significant effect on yields. For example, in 1945, the December application proved an inferior method at both the 5- and 10-ton rates (Treatments 5 and 6). In 1948, the sidedressing method at the 5-ton rate (Treatment 12) was inferior while the 10-ton December application method (Treatment 6) was significantly superior to other methods of application. Yields were consistently high, however, when poultry manure was applied just before (Treatments 7 and 9) or after plowing in April (Treatments 10 and 11)—the latter time of application being slightly better.

Although the use of ten instead of five tons of manure per acre resulted in average increases of about a ton per acre, these increases were due largely to the huge increase of around four tons obtained in 1946.

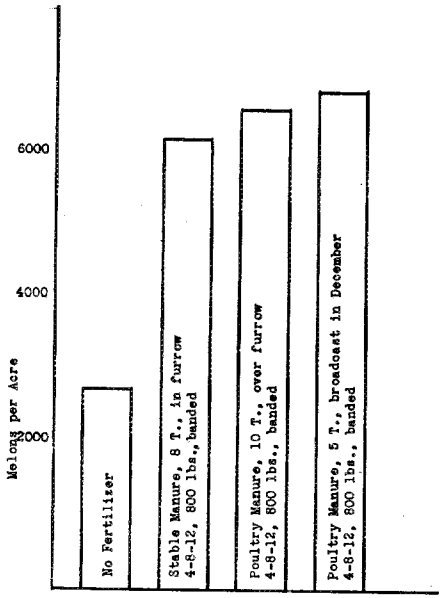

Figure 2. A comparison of average (4 years) cantaloupe yields showing that poultry manure may be satisfactorily substituted for less plentiful stable manure.

In the other three years, the 10-ton rate was not usually significantly better than the 5-ton rate. In several cases it produced significantly lower yields. Usually this was due to rotting of fruit or to the pickers overlooking fruits under the dense foliage, and was most serious when moisture was abundant. It would appear, therefore, that in an average year, five tons of poultry manure per acre might be sufficient for maximum yields.

The use of superphosphate with poultry manure for conservation of nitrogen and for making a more balanced fertilizing material was of no apparent value so far as tomato yields were concerned. The average yield from plots (Treatment 7) with and without the addition of superphosphate to the manure (Treatment 8) was 7.61 and 7.87 tons per acre, respectively.

Likewise, 100 pounds of muriate of potash (60%) per acre in addition to five tons of poultry manure proved to be of no value for tomatoes. The yields with (Treatment 4) and without the potash (Treatment 2) were 7.80 and 7.56 tons per acre, respectively.

Cantaloupes

Yearly and average results from the cantaloupe experiments are presented in Table 4. Stable manure along with 4-8-12 fertilizer was used in Treatment 1 as a basis for comparison. Poultry manure along with 4-8-12 fertilizer brought about the highest average yields as is illustrated in Figure 2. The two most effective treatments and their four-year-average yields were as follows: Poultry manure broadcast on the cover crop in December, 5 tons per acre, with 800 pounds of 4-8-12 banded at seeding (Treatment 8), 6853 melons; and poultry manure broadcast over open furrows, 10 tons per acre, with a similar application of 4-8-12 (Treatment 11), 6635 melons. The yield where stable manure was placed in furrows, 8 tons per acre, with a similar application of 4-8-12 (Treatment 1) was 6200 melons per acre. These two poultry manure treatments were not only highest in number of melons, but also in weight of melons per acre and percentage of jumbos (melons five inches or over in diameter).

Two other methods of manure application, in the furrow (Treatments 5 and 7) and sidedressed (Treatments

Table 4. Effectiveness of Poultry Manure, Stable Manure, and Certain Commercial Fertilizers on the Marketable Yield of Cantaloupes.

Treatment (Application per Acre)	Number of Melons per Acre					Per Cent Jumbos	Average Tons per Acre
	1945	1946	1947	1948	Averag		
1. Stable Manure, 8 tons, in furrow + 4-8-12, 800 lbs., banded	6912	4734	8305	4848	6200	60	8.95
2. Poultry Manure, 3 tons, in furrow	5634	4589	6970	3745	5235	48	6.87
3. Poultry Manure, 5 tons, in furrow	5489	4909	7347	4267	5503	53	7.53
4. Poultry Manure, 3 tons, in furrow + Muriate of Potash (60%), 60 lbs., broadcast after plowing	3630	5315	7550	3193	4922	55	6.84
5. Poultry Manure, 3 tons, in furrow + 4-8-12, 800 lbs., banded	4821	4386	7521	4035	5191	57	7.25
6. Poultry Manure, not treated with superphosphate, 3 tons, in furrow + 4-8-12, 800 lbs., banded	7928	5431	7318	4180	6214	56	8.88
7. Poultry Manure, 5 tons, in furrow + 4-8-12, 800 lbs., banded	4182	4734	7986	4615	5379	54	7.92
8. Poultry Manure, 5 tons, broadcast in December + 4-8-12, 800 lbs., banded	7608	5344	8422	6038	6853	64	10.12
9. Poultry Manure, 10 tons, broadcast in December + 4-8-12, 800 lbs., banded	6563	4531	7986	7199	6570	59	9.31
10. Poultry Manure, 5 tons, over furrow + 4-8-12, 800 lbs., banded	6127	5228	8073	5312	6185	57	8.50
11. Poultry Manure, 10 tons, over furrow + 4-8-12, 800 lbs., banded	6795	5693	7202	6851	6635	62	9.52
12. Poultry Manure, 5 tons, sidedressed + 4-8-12, 800 lbs., banded	4559	4531	7492	4964	5387	55	7.52
13. Poultry Manure, 10 tons, sidedressed + 4-8-12, 800 lbs., banded	4356	4386	7608	6764	5779	56	8.24
14. Nothing	2265	2585	3717	2554	2780	42	3.26
L.S.D. at 5% point	2019	1358	1513	1420	918	—	1.03

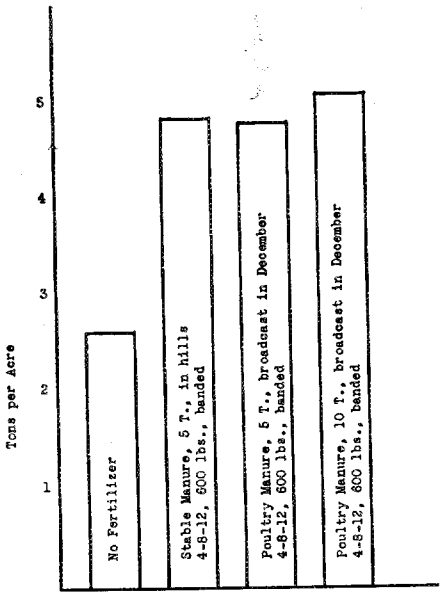

Figure 3. A comparison of average (4 years) watermelon yields showing that poultry manure may be satisfactorily substituted for much less plentiful stable manure.

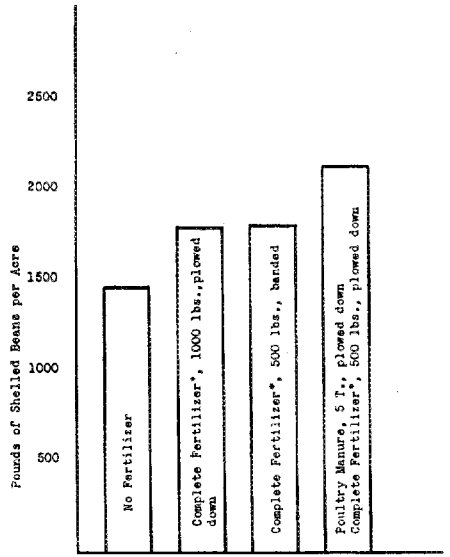

Figure 4. A comparison of average (4 years) lima bean yields showing the superiority of poultry manure plus commercial fertilizer over commercial fertilizer alone.

*5-10-10 was used except in 1948 when 4-8-12 fertilizer was used.

12 and 13), were inferior. When broadcast in December, five tons (Treatment 8) was as good as ten tons per acre (Treatment 9). However, when broadcast over open furrows the 10-ton rate (Treatment 11) was considerably, though not significantly, better than the 5-ton rate (Treatment 10).

As with tomatoes, the treatment of manure with superphosphate, 100 pounds per ton, in broiler houses was of no value for increasing yields of cantalopes—in fact higher yields resulted where the manure was left untreated (cf. Treatments 5 and 6). Likewise, supplementing poultry manure with applications of muriate of potash (60%), 60 pounds per acre (cf. Treatments 2 and 4), or 4-8-12, 800 pounds per acre banded (cf. Treatments 2 and 5, 3 and 7), had no significant effect on yields.

Watermelons

Results of the watermelon experiments are presented in Table 5. Although yield differences resulting from the four methods of applications were not statistically significant, it is noteworthy that, as with cantaloupes, broadcasting the manure on the cover crop in December gave the highest yields. Broadcasting the manure over furrows was the next best method. As is illustrated graphically in Figure 3, the average yield from the stable manure treatment (Treatment 1) was 4.86 tons, while those from the 5- and 10-ton poultry manure treatments made in December (Treatments 8 and 9) were 4.82 and 5.10 tons, respectively. In other words, poultry manure was at least as effective as stable manure for watermelon production when applied in this manner. The 10-ton rate was not much better than the 5-ton rate and would hardly be justified on the basis of these results.

Table 5. Effectiveness of Poultry Manure, Stable Manure, and Certain Commercial Fertilizers on the Marketable Yield of Watermelons.

Treatment (Application per Acre)	Tons per Acre					Average Wt. of Fruit, lbs.
	1945	1946	1947	1948	Average	
1. Stable Manure, 5 tons, in hills + 4-8-12, 600 lbs., banded	8.87	2.50	2.99	4.08	4.86	21
2. Poultry Manure, 2 tons, in hills	8.18	1.91	3.90	2.68	4.17	20
3. Poultry Manure, 4 tons, in hills	6.93	1.12	2.54	3.32	3.48	20
4. Poultry Manure, 2 tons, in hills +Muriate of Potash (60%), in 60 lbs., broadcast after plowing	7.65	1.26	3.74	4.26	4.23	21
5. Poultry Manure, 2 tons, in hills + 4-8-12, 600 lbs., banded	5.96	1.78	4.08	6.52	4.59	21
6. Poultry Manure, not treated with superphosphate, 2 tons, in hills + 4-8-12, 600 lbs., banded	8.14	1.50	2.04	4.24	3.98	19
7. Poultry Manure, 4 tons, in hills + 4-8-12, 600 lbs., banded	6.59	2.10	2.73	5.20	4.16	21
8. Poultry Manure, 5 tons, broadcast in December + 4-8-12, 600 lbs., banded	7.46	1.56	4.28	5.98	4.82	21
9. Poultry Manure, 10 tons, broadcast in December + 4-8-12, 600 lbs., banded	7.24	1.26	3.92	7.96	5.10	20
10. Poultry Manure, 5 tons, over furrow + 4-8-12, 600 lbs., banded	6.89	2.15	4.52	3.88	4.36	21
11. Poultry Manure, 10 tons, over furrow + 4-8-12, 600 lbs., banded	8.38	1.42	3.99	4.92	4.68	21
12. Poultry Manure, 5 tons, sidedressed + 4-8-12, 600 lbs., banded	7.47	1.45	3.23	2.41	3.64	20
13. Poultry Manure, 10 tons, sidedressed + 4-8-12, 600 lbs., banded	7.66	0.76	3.53	3.10	3.76	20
14. Nothing	7.71	0	2.35	0.51	2.64	19
L.S.D., 5% point	N.S.	N.S.	1.52	2.85	1.94	—

Other methods of application—over furrows (Treatments 10 and 11), in hills (Treatments 5 and 7), and sidedressed (Treatments 12 and 13)—gave lower yields, though not significantly lower. Treatment of

Table 6. Effectiveness of Poultry Manure and Certain Commercial Fertilizers on Yields of Lima Beans

Treatment per Acre	Pounds of Shelled Beans per Acre				
	1944	1945	1946	1948	Average
1. Poultry Manure, 5 tons, plowed down + Complete fertilizer[1], 500 lbs., plowed down	866	3356	1401	2877	2125
2. Complete fertilizer, 500 lbs., plowed down + Poultry Manure, 5 tons, broadcast after plowing	942	3694	1343	—	—
3. Complete fertilizer, 500 lbs., plowed down + Poultry Manure, 5 tons, sidedressed	742	—	—	—	—
4. Complete fertilizer, 500 lbs., banded	790	3084	755	2565	1799
5. Complete fertilizer, 1000 lbs., plowed down	746	3128	1052	2238	1791
6. Nothing	812	2418	749	1850	1457
L.S.D. at 5% point	121	638	320	100	—

[1]5-10-10 was used except in 1948 when 4-8-12 was used.

poultry manure in the broiler houses with 100 pounds of superphosphate per ton resulted in increasing average yields from 3.98 to 4.59 tons per acre (cf. Treatments 5 and 6). This increase, 0.61 tons, was not significant statistically, however, and cannot be taken to justify the treatment of manure with superphosphate. Likewise, the use of muriate of potash (60%), 60 pounds per acre (cf. Treatments 2 and 4), or 600 pounds of 4-8-12 banded (cf. Treatments 2 and 5; and 7), in addition to poultry manure in hills did not significantly increase yields.

Lima Beans

Results of the lima bean experiments are presented in Table 6. In these experiments poultry manure at the rate of 5 tons per acre plus commercial fertilizer is compared with commercial fertilizer alone. The results show that poultry manure considerably increased average as well as annual yields. This is illustrated graphically in Figure 4. Commercial fertilizers alone (Treatments 4 and 5) produced average yields of 1791 and 1799 pounds of shelled beans per acre while a combination of manure and fertilizer (Treatment 1) produced 2125 pounds. This represents about a 19 per cent increase.

Manure was applied both just before (Treatment 1) and right after plowing (Treatment 2) for a three-year period. No significant differences in yields were observed between these two times of application. Sidedressing beans with manure three weeks after planting (Treatment 3) was tried one year but was found to be an inferior method.

DISCUSSION

The belief that poultry manure causes plants to produce excess foliage at the expense of seeds and fruits was not borne out in these experiments. Crop plants were considerably larger (Figure 5 and 6) and had a denser foliage where manure was used; but yields instead of being lower were much greater. Plants were larger and foliage was particularly heavy where poultry manure was applied in December (Figure 5 and 6). Yields of cantaloupes and watermelons from this method were correspondingly greater. With tomatoes this method was the best in two years out of four, but in 1945 when there was an abnormally heavy July rainfall, gave inferior yields because many fruit rotted under the dense foliage.

The method wherein manure was applied in December may have been superior for several reasons, namely; (a) much more green manure was plowed down; (b) the manure had more time to be broken down by microbes thus making the nutrients contained more readily available; (c) there was less possibility of toxic effects from the manure due either

Figure 5. Effect of various fertilizer treatments on size of tomato plants. Pictures taken on August 18, 1948. Treatments were as follows, top to bottom: no fertilizer or manure; 1200 lbs. of 4-8-12 plowed down; 5 tons of poultry manure broadcast after plowing plus 600 lbs. of 4-8-12 plowed down; 5 tons of poultry manure broadcast in December plus 600 lbs. of 4-8-12 plowed down.

Figure 6. A comparison of stable and poultry manures for cantaloupes. Pictures taken on August 18, 1948. Treatments were as follows: Upper, 8 tons of stable manure in furrow plus 800 lbs. of 4-8-12 banded; lower, 5 tons of poultry manure broadcast in December plus 800 lbs. of 4-8-12 banded.

from ammonia or disturbed moisture relations.

In previous experiments (5) poor stands of cantaloupes resulted in dry years when poultry manure was placed in furrows; however in years of good rainfall, yields from this method were good especially when manure was applied at least a month before seeding. In experiments reported, herein, none of the years could be considered dry years. Nevertheless, the "in-furrows" method was inferior with cantaloupes, although the "in-hills" method was good with watermelons at the rates used. On the basis of these and other experiments, it appears that these two methods of poultry manure application, should not be used because of the possibility of decreasing stand and yield in dry years.

The fact that poultry manure alone produced as many tomatoes as poultry manure plus commercial fertilizer seems unbelievable at first. Yet when one considers that 5 tons of poultry manure contain a generous supply of nitrogen, phosphorus, potassium, as well as other nutrients, these results become explainable. Brasher (1) under Delaware conditions found that tomato yields were not significatnly affected over a three-year period when many different fertilizer ratios were used. According to Hester (4), approximately 100 pounds of nitrogen, 30 pounds of P_2O_5, and 175 pounds of K_2O are required to produce 10 tons of tomatoes per acre. Five tons of poultry manure supplies most of these requirements without the addition of a commercial fertilizer.

In the tomato experiments, poultry manure, when based on yield increases over the no-fertilizer treatment was worth $22.00 per ton at the 5-ton rate and $12.00 per ton at the 10-ton rate. When used with commercial fertilizer and based on yield increases over the 1200-pound fertilizer treatments and the 50 per cent saving in fertilizer, poultry manure was worth $13.00 per ton at the 5-ton rate and $10.00 per ton at the 10-ton rate.

In the lima bean experiments, poultry manure at a 5-ton rate, when used with commercial fertilizer, was worth $4.50 per ton based on yield increases over the commercial fertilizer treatments. The price allowed for beans in these calculations was seven cents a pound.

There were indications in these experiments that poultry manure compared with commercial fertilizer or stable manure delays yields slightly. Results, however, were not consistent and the differences in maturity were slight and of little significance.

From observations in this series of experiments, it is believed that poultry manure did not increase the weed population. It did, however, cause the weeds, as it did the cultivated crop, to grow more rapidly and reach a greater size. Although this was true, the weeds were satisfactorily controlled by the usual methods. Additional experimental work along this line is needed to fully evaluate the weed problem connected with poultry manure applications.

Use of poultry manure in most cases brought about a slight increase in soil organic matter and plant-nutrient content, according to analyses of soil samples taken before and after the four-year period. The results, however, were inconsistent and no particular method of application was outstanding.

SUMMARY

The results of a four-year study of the value of poultry manure and the most effective methods for its application for tomatoes, cantaloupes, watermelons, and lima beans are presented on the foregoing pages. The manure used was broiler-house manure, which is so plentiful in southern Delaware. Moisture was not a limiting factor in any of the four years.

Poultry manure was very effective for increasing tomato yields. Method of application was not so important although broadcasting after plowing gave slightly better and more consistent results. An application of 1200 pounds of 4-8-12 fertilizer alone, produced an average yield of 5.89 tons while 600 pounds of fertilizer plus 5 and 10 tons of poultry manure produced 7.75 and 9.12 tons, respectively. The 10-ton rate was significantly superior to the 5-ton rate, however, in only one out of four years. Poultry manure was just as effective alone as when supplemented with 4-8-12 fertilizer, muriate of potash, or when treated with superphosphate in the broiler house.

Poultry manure was just as effective as stable manure for cantaloupe production. It was most effective when broadcast on the rye or wheat cover crop in December. A 5-ton rate was sufficient. A second method, straddling open furrows in March with a manure spreader using a 10-ton per acre rate, was nearly as good. As with tomatoes, poultry manure was just as effective alone as when supplemented with 4-8-12 fertilizer, muriate of potash, or when treated with superphosphate in the broiler house.

As with cantaloupes, poultry manure was as effective as stable manure

for watermelon production. It also was most effective when broadcast on the cover crop in December. The 10-ton rate was slightly better than the 5-ton rate. The use of 4-8-12 fertilizer and muriate of potash in addition to the manure or treating the manure with superphosphate in the broiler house increased yields slightly though not significantly.

Poultry manure was very effective for increasing lima bean yields. A combination of complete fertilizer and five tons of poultry manure per acre, greatly increased the yield over a complete fertilizer alone. It made little difference, however, whether the manure was broadcast before or after plowing. In a single test, side-dressing was an inferior method of manure application.

RECOMMENDATIONS

With the foregoing experimental results as a guide, the following recommendations for the use of poultry manure are made for soils of average fertility. Although the use of complete fertilizer in addition to poultry manure appeared unnecessary in these experiments, its use in moderate amounts is recommended to insure that soil fertility over a wide range of soil and climatic conditions will not be a limiting factor for the production of the highest possible yields. Superphosphate need not be added to poultry manure for this practice has not increased yields.

Tomatoes—Five tons of poultry manure per acre broadcast on cover crop during winter or just before or after plowing in spring plus 600 pounds of 4-8-12 fertilizer plowed down. The winter application makes for the greatest plant size.

Cantaloupes—Five tons of poultry manure per acre broadcast on cover crop during winter plus 600-800 pounds of 4-8-12 fertilizer banded at seeding.

Watermelons—Five tons of poultry manure per acre broadcast on cover crop during winter plus 600 pounds of 4-8-12 banded at seeding.

Lima Beans—Five tons of poultry manure per acre broadcast before or after plowing plus 500 pounds of 4-8-12 banded at seeding.

LITERATURE CITED

1. Brasher, E. P. Factors influencing tomato production in Delaware. Del. Agr. Expt. Sta. Bul. No. 277 (1949).
2. Donaldson, R. Poultry manure, its use and preservation. Mass. Agr. Ext. Service Leaflet 57 (1943).
3. Greve, E. W. Utilization of poultry manure in strawberry production. Del. Agr. Exp. Sta. Bul. No. 244, p. 30 (1943).
4. Hester, J. B., and Shelton, F. A. The soil side of tomato growing. Campbell Soup Company Bul. No. 1 (1939).
5. Rahn, E. M. The influence of rainfall on the response of cantaloupes to manures and commercial fertilizers. Proc. of Amer. Soc. Hort. Sci. 47:343-346 (1946).
6. ————————. Yields of cantaloupes as affected by time of placement of manures in furrows. Proc. of Amer. Soc. Hort. Sci. 49: 277-280 (1947).
7. ————————, and Phillips, W. H. The effect of various fertilizer and manure treatments on the yield, size, stand, and disease resistance of cantaloupes. Del. Agr. Exp. Sta. Bul. No. 256 (1945).
8. White, J. W., Holden, F. J., and Richer, A. C. Production, composition, and value of poultry manure. Pa. Agr. Exp. Sta. Bul. No. 469 (1944).
9. Yushok, W., and Bear, F. E. Poultry manure, its preservation, deodorization, and disinfection. N.J. Agr. Exp. Sta. Bul. No. 707 (1943).